Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Section 68.4(a) of the Commission's Rules	)	WT Docket No. 01-309
Governing Hearing Aid-Compatible Telephones	)	RM-8658
	)	
	)	

COMMENTS OF THE TELECOMMUNICATIONS INDUSTRY ASSOCIATION

Matthew J. Flanigan
President

Grant E. Seiffert
Vice President
External Affairs and Global Policy

Derek R. Khlopin
Director, Law and Public Policy

1300 Pennsylvania Avenue, NW
Suite 350
Washington, DC 20004

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The Telecommunications Industry Association ("TIA")[1] hereby comments in response the Commission's Notice of Proposed Rulemaking[2] in the above-captioned proceeding. TIA and its member companies, which notably include manufacturers of cellular phones, continue to believe in the critical importance of hearing aid users having the ability to enjoy the use of modern essential communications tools such as cell phones. TIA member companies continue to introduce a wide variety of innovative products and service features that play a role in facilitating such access. For very real technical reasons, however, a cell phone manufacturer is limited in the control it has over whether a hearing aid user can effectively use one of its phones. A removal of the exemption of cell phones from the requirements of the Hearing Aid Compatibility (HAC) Act[3] thus would not lead to the result universally desired. TIA therefore instead calls on

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[1] TIA is a full-service national trade organization with membership of over 1,100 large and small companies that provide communications and information technology products, materials, systems, distribution services and professional services in the United States and around the world. The association's member companies manufacture or supply virtually all of the products used in global communications networks. TIA, accredited by the American National Standards Institute (ANSI), develops voluntary global industry standards for a wide variety of telecommunications products.

[2] *In the Matter of Section 68.4(a) of the Commission's Rules Governing Hearing Aid-Compatible Telephones,* WT Docket No. 01-309, RM-8658, Notice of Proposed Rulemaking, FCC 01-320 (rel. Nov. 14, 2001) ("the *NPRM*").

[3] 47 U.S.C § 610.

the Commission to work with the cellular phone and hearing aid industries, along with consumer representatives, to seek cooperative solutions that can help prevent the design of a hearing aid from unintentionally frustrating a consumer's effective use of this important communications tool.

I. INTRODUCTION: THE HAC ACT WAS AIMED AT YESTERDAY'S PROBLEMS; IT IS TIME TO ADDRESS TODAY'S AND TOMORROW'S CHALLENGES

The cellular phone manufacturers represented by TIA want every person who uses a hearing aid to be able to use a cell phone. Indeed, this industry would like everyone to be able to use its products and services. Not only is it in the public interest for *all* consumers to have access to cellular phones, but, as Commissioner Michael Copps observed in his separate statement on the NPRM,[4] it also is good for business to have more potential customers, and cellular service becomes more valuable and attractive as more people are added to the network. Furthermore, the cellular industry understands that making our products easier to use for people with disabilities many times will make them easier to use for people without disabilities as well. In situations that impose limits on the consumer's ability to see or hear or touch the phones -- such as noisy environments, quiet environments, situations where the user needs his or her hands for other tasks, or where there is limited ability to look at the phone -- such easier use benefits all cell phone users.

In order to achieve this objective, manufacturers have designed and offer a variety of features that facilitate the use of cell phones by persons with disabilities. These include, for

example, vibrating alert, neck loops, earpieces, headphones, speakerphones, phones that couple with telecoil hearing aids, increased font size on displays, volume control, use of standardized icons, text messaging, voice recognition capabilities, one-button dialing, and auto dialing. To get to the point where everyone who uses a hearing aid can also use a cell phone, however, it is necessary to look not only at the cell phone but also at the hearing aid for solutions as well. As is described below, Australia, for example, already has made great strides in solving this hearing aid and cell phone problem. Like virtually every successful effort to solve interference problems, the Australian solution involved making changes to the device that was picking up interference, so that the interfering signal was rejected and did not affect the intended operation of the device.

The HAC Act was passed in 1988 and requires that phones "provide internal means for effective use with hearing aids that are designed to be compatible with telephones that meet established technical standards for hearing aid compatibility."[5] The intent of this legislation was focused on "coupling" the telecoil found in some hearing aids with the magnetic fields generated by the receivers used in telephone handsets at the time. Technical standards were developed, and HAC or more precisely "hearing aid coupling" was achieved, through the production of wireline phones that generated a defined audio magnetic field at the earpiece that coupled to hearing aids that were equipped with a standard telecoil. As the Commission notes, the statute only requires compatibility or coupling with respect to hearing aids designed to be compatible with phones that meet this telephone standard.[6] Such wireline telephones are now labeled as "hearing aid

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[4] *See* Separate Statement of Commissioner Michael J. Copps, Re: *Section 68.4 of the Commission's Rules Governing Hearing Aid-Compatible Telephones, Notice of Proposed Rulemaking (rel. Nov. 14, 2001).*
[5] 47 U.S.C. § 610(b)(1).
[6] *NPRM* at ¶ 18.

compatible." When the HAC Act passed, a vast majority of phone use was wireline, with cellular phones still in their infancy. The initial statutory and then regulatory exemption for cell phones reflected recognition by both Congress and the Commission that the HAC Act coupling solution might not be appropriate for a new and rapidly changing wireless technology.

In retrospect, the wisdom of the decision to exempt cell phones has been confirmed. Mobile phone technology has evolved rapidly. Manufacturers moved ahead to develop multiple approaches to making their products easier to use for people who are hard of hearing. Some approaches have been successful; others have not. In particular, manufacturers designed cellular phones that couple with standard telecoil hearing aids, despite the exemption of wireless phones from the requirements of the HAC Act. In fact, users of standard telecoil hearing aids can go out today and purchase both analog and digital cell phones equipped with standard telecoil capability that will couple with those hearing aids.[7]

While this addresses the problem in the way contemplated by the HAC Act when it was passed, telecoil coupling alone will not solve the problem for many hearing aid wearers today, because the world and products have moved on. As a result of technology advances over the past 13 years, the HAC hearing aid telecoil solution is not sufficient to achieve the overarching goal of reaching a point where everyone with a hearing aid can use a cell phone. This is what TIA understands that the advocates representing people who are hard of hearing want and it is what the cell phone industry wants.[8] Why is the goal not yet realized and what can be done to

[7] Manufacturers also have developed neck loops that couple with telecoil hearing aids, as well as speakerphones and other means of using cell phones with hearing aids.

[8] The issue oftentimes gets confused because the "C" in HAC stands for "compatibility" in the coupling sense, whereas the interference issue is the "C" in electro-magnetic compatibility or "EMC."

further advance this goal? Understanding the answers to these questions is the focus of these TIA comments.

First, hearing aids have evolved and, as the Commission is aware, most of them purchased today do not have the standard telecoil. Thus, even "compatible" standard telecoil coupling cell phones cannot internally couple with those hearing aids (*i.e.* a hearing aid that does not have a standard telecoil). Second, digital cell phones have essential and required transmissions that are often unintentionally picked up by the hearing aid electronics, causing interference, especially when the device is pressed up against the hearing aid. The embedded base of hearing aids and the majority of hearing aids on the market do not have sufficient immunity to radiofrequency ("RF") interference to prevent this. Even if there is compatible telecoil coupling with the hearing aid, it may be a challenge to use the cell phone if the hearing aid itself does not have sufficient RF immunity.

Therefore, compliance solely with the HAC telecoil compatibility requirement is not the answer to the problem. Even if every digital cell phone was compatibly equipped with telecoil capability, only approximately 20 percent of hearing aid wearers have telecoils, so this only would pertain to about 20 percent of modern hearing aids and it also would not address the interference issue. TIA urges the Commission to devote this proceeding to addressing the more fundamental question of how to best and most efficiently get to a point where everyone who acquires a hearing aid can use a cell phone with that hearing aid. This is the ultimate goal of both industry and hard of hearing consumers.

To reach the goal, the RF interference problem has to be solved. In essence, it is necessary to find a way to keep unwanted frequencies from interfering with the circuitry of the hearing aid. To suggest that this can be done by somehow redesigning the cell phone betrays a misunderstanding of the nature of the technological problem and of the limited flexibility of a cell phone. If it is to perform its basic goal of letting mobile users communicate from anywhere, a cell phone must transmit an RF signal in a certain frequency bandwidth specified by the Commission, at the specified power levels for cellular systems, at a pulse rate established by industry standards, in all directions.[9]

As an analogy, one could think of a cell phone as a RF "lighthouse," sending out a regulated pulsed beam in all directions. If the cell phone does not send the beam out in all directions, it will not connect with the base station tower, which can be located anywhere in proximity to the phone. The best way to keep that RF light from trespassing into a room of a nearby house would not be to try to shutter the lighthouse; it simply would be to pull down a shade in the room. As discussed below, the cell phone industry, which makes its own products immune to RF interference, stands ready to help hearing aid manufacturers or designers make their products more impervious to cell phone signals. This generally can be done with circuit changes that are modest and with parts that are inexpensive. In fact, there has been an increase in immunity in some models of hearing aids already and some hearing aid manufacturers advertise that their aids work with cell phones.

[9] *See* 47 C.F.R. §§ 22.913, 24.232.

II. BETTER UNDERSTANDING THE TWO TECHNOLOGIES INVOLVED

In order to address the problem of interference wisely, it is essential to first understand the two products and technologies involved. Each has a very different purpose and a different set of parameters within which it must operate. By understanding these, the best path for solving the interference issue becomes clearer.

A. Cellular Telephones

Cellular telephones are designed to send a very specific type of signal several miles if necessary to connect through a cell tower to a sophisticated communications system that requires almost perfect matching of the signal characteristics and the system design characteristics. Thus, the cell phone must operate within strict technical parameters, like a train on a track or a ship in a channel. *Any* significant variation from these specifications will not only result in a cell phone that does not work, but may play havoc with the cellular system itself or with neighboring radio technologies.

First, cell phones must operate in their assigned frequency band, either 800 or 1900 MHz in the U.S. Within that frequency band prescribed by the Commission, the cell phone must also move precisely to the specific channel frequency that has been assigned for the particular call that it is handling. The cell phone absolutely must stay within these narrow confines if it is to operate at all. It is well understood that any electronic device that either intentionally or unintentionally picks up or senses this frequency has the potential for suffering interference. Indeed, any potential receptor can pick up any RF signal inadvertently – stories abound of people picking up FM stations in their dental work and electrical engineers understand why that occurs.

Second, cell phones are required to operate at standardized/regulated power levels.[10] The power levels have to be strong enough to reach distant cell towers with a clear signal. If the cell phones cannot do this, the system simply will not work and the phone will be useless. The power levels in cell phones today are dynamic: each phone has multiple power levels and these power levels are standardized by the industry to keep phones at the lowest power level needed to reach the nearest tower clearly. The signal power must be available in whatever direction the cell tower is located. It cannot be focused in one direction; it must transmit in all directions.

Third, in digital cell phone technologies, the digital packages are sent in very short, timed, digital bursts called "pulses" throughout the course of the call itself. It is this aspect of the technologies that permits the much more efficient use of spectrum for digital systems. However, in order to accomplish this without any noticeable effect on the quality of the call, the protocol, length, spacing and format of these pulses must be exactly as specified for the particular technology. These parameters are all detailed in industry adopted public standards for the particular technology, *e.g.* CDMA, GSM, and TDMA. Of course, any such signal must be sent at the frequency band, at the power level, and with the omni-directional nature of the phone's signal. Any device that either intentionally or unintentionally picks up such a pulsed signal can be affected by the pulse rate set for that technology.

Fourth, cell phones today are designed so that they can be used at the ear or removed from the ear, with the use of an earpiece or headset. While the connection to the headset or earpiece

generally has been accomplished through a wire connected through a 2.5 mm standardized jack to the wireless device, the next generation of wireless devices will include some models that have wireless connections using Bluetooth or other low-power wireless formats. Some phones also are designed for use as a speakerphone or with speakerphone accessories. A hearing aid device that picks up interference from a cell phone held only millimeters away at the ear may suffer no significant cell phone interference when any of these alternative modes of use are employed. In this sense, at least, the solution to the interference problem already is available to most hearing aid users.

Finally, the laws of physics mandate that generating the RF signal and sending a signal of this power will create an electro-magnetic field in the immediate vicinity of the phone and antenna, and that field will pulse with the cell phone's pulse rate. The electro-magnetic field can be controlled to a limited degree, but it cannot be eliminated. Moreover, the field generated by the phone in isolation would change when it is brought in close proximity to another physical mass, such as the head or hearing aid. It would change again if it was moved to a different position at the head, and change again with the addition of an accessory.

B. Hearing Aids

Hearing aids basically are designed to take low to moderate level audible sounds in the outside world and boost them or transform them so that someone who could not hear the sounds can now hear them. The major challenge for hearing aid conceptual designers is how to

[10] *See generally* 47 CFR § 2.1046 for the compliance requirements on cell phones. Participants in the telecommunications industry generally satisfy these requirements through adherence to industry-developed

reproduce distinguishable "sounds" that a person can "hear" even though the person has a hearing loss. This requires some form of sensitive microphone to pick up the sound, some form of amplifier or transformation circuitry, a speaker or other device to regenerate the "sound" and a battery to drive these operations. Hearing aid manufacturers essentially are free to design the device circuitry any way they want and to try any method they can devise to help the person hear what he could not before. Thus, new, slightly different ways to accomplish this difficult feat are regularly developed.

The major restraints on hearing aid design are size and power drain. The hearing aid (or at least the speaker) needs to be small enough to ride on or in the ear, and if the whole device is at the ear, it must operate for a considerable period of time on a very small battery. Thus, hearing aids are marvels of miniaturization. Because the hearing aid is supposed to pick up only audible sounds -- the same sounds that people without hearing loss usually hear -- no reason exists to design the microphone, circuitry or speaker in the hearing aid to pick up or be sensitive to any frequency or pulse that is not in the audible range. The ideal hearing aid in the acoustic mode picks up and repeats only what is audible to the human ear.

Hearing aid circuit design is a critical factor in attempting to attain this ideal by avoiding interference to the hearing aid. How the hearing aid manufacturer designs its circuits and parts will determine whether the hearing aid picks up or is affected by frequencies or fields other than the desired audible frequencies. Unfortunately, many types of electronic components can pick up other (unintentional) frequencies in certain designs or applications. Optimized circuit designs can minimize or avoid this interference. As a result of this linkage to circuit design, a wide

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standards facilitated by standards development organizations such as TIA.

variation exists in immunity levels among hearing aids. Some hearing aids pick up almost no interference from the surrounding environment, capturing and repeating only the intended audible sounds. Others, however, pick up considerable unintended frequencies, pulses and fields, which, if strong enough, can create annoying or even overpowering interference that is picked up in the sensitive electronics of the hearing aid, which can be heard as interference by the user.

It is these variations, for example, in the hearing aid circuitry, design and immunity level that has led to reports of little interference with some hearing aids and some digital wireless phones. Unfortunately, this does not mean that the interference problem was solved in the wireless handset. Preliminary tests of some cell phones have shown that certain cell phones do work better with some hearing aids but not with all. This is what one would expect. It is inherent to a cell phone design that there will be interference with any hearing aid that is not sufficiently immunized against the frequencies and fields of that mobile device.

In the U.S., no mandatory industry standards appear to exist for hearing aid manufacturers to minimize unintentional interference. Unlike the cell phone, which has very strict standards and specifications about what frequencies and pulses it must receive and send, TIA is not aware of any current U.S. requirements for hearing aids to capture only the intended audible frequencies. Thus, no formal requirements exist that prevent a hearing aid manufacturer from inadvertently designing its circuitry in such a way that (in addition to audible sounds) it also picks up the frequency of a cordless phone, FM channel 100.3 or TV channel 5. Even electrical or electronic sources that are not intentional radiators of frequencies, such as

fluorescent lights and CRT screens, can be picked up by some hearing aids and create static. It is important to note that not all hearing aids are equally affected; many are designed in such a way that sensitivity to such undesirable frequencies and pulses is minimized, and these products receive relatively little interference.

Finally, some hearing aids are sensitive to having any object held up against them. In some cases, holding a pack of cards up to the ear will generate feedback. If that deck of cards is replaced by a cell phone, the same feedback will occur, even if the phone has been turned off. In fact, this is one thing that telecoil coupling was designed to address. A hearing aid that does not have a circuit design to eliminate such feedback will be of limited use when any object is held to the ear.

III. HEARING AIDS MUST BE DESIGNED WITH INCREASED IMMUNITY TO ENABLE HEARING AID WEARERS TO USE A CELL PHONE

Because no requirements or standards exist for hearing aid design in terms of rejection of unwanted frequencies, there also can be no predictability as to what frequencies or fields future hearing aids will and will not pick up. As long as this continues to be the case, it remains possible that a present or future hearing aid will have circuitry that is inadvertently interfered with by 800 MHz or 1900 MHz signals, or that resonates to pulse rates of a digital phone.

It therefore is technically infeasible to solve the interference problem by only looking at cell phones. As the Commission notes in its *NPRM*, "design of the hearing aid is beyond the

control of the wireless industry."[11] If a hearing aid suffers interference from the RF frequency at which the cell phone operates, nothing can be done to avoid the interference except turning the phone off. The same is true for any hearing aid that is designed with circuitry that (unintentionally) picks up the pulse rate of a particular phone technology. That frequency and that pulse rate have to be transmitted to towers miles away. Thus, some hearing aids that have no protection suffer interference from cell phones across a room. There is nothing the cell phone manufacturer can do to prevent it, except again to turn the phone off. One might just as well tell a FM radio station to prevent its signal from being picked up by a ham radio operator tuning to the radio station's licensed frequency.

The Commission itself appears to recognize that the solution to this problem lies primarily in the hearing aid design. In its *NPRM*, the Commission notes that: "The extent of the interference appears to depend on the following factors: the air interface the handset uses . . ., the design and filtering capabilities of the hearing aid, the amount the hearing aid detects and amplifies the audio signal, the distance of the transmitter from the hearing aid, the signal strength from the transmitter, and the individual's level of hearing loss."[12] Of these factors, the two relating to the cell phone – the air interface and the signal strength – are predetermined and cannot be significantly changed if the phone signal is to find and interface with a distant tower operating on that particular interface technology. The other factors (aside from the user's level of hearing loss and how far away he holds the phone) are of hearing aid design that can be (and in some cases have been) modified to address the interference problem. Thus, this is where the solution predominantly lies.

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[11] *NPRM* at ¶ 25.
[12] *Id.* at ¶7.

As discussed below, detailed studies of this issue have reached the same conclusion. The primary solution is to use well-recognized technologies to immunize hearing aids from the signals and pulses that cell phones must send. Once this is done, a vast majority of the interference will disappear. If, at that point, interference issues remain with regard to some cell phones, these issues can be addressed with the knowledge that the core causes of RF interference have been resolved.

This better understanding in essence addresses almost all of the questions the Commission poses in the *NPRM*. Generally, only potential harm would result from withdrawing the HAC Act exemption until a joint effort has been successful in making hearing aids immune to the pulsed signal that digital cell phones must transmit.[13] Just as the HAC Act solution for wireline phones was premised on the hearing aids having telecoil capability, any further steps toward a solution by the digital cell phone manufacturers is premised on hearing aids having a good level of immunity to these essential transmissions.[14] This prerequisite state of affairs has not yet been attained.[15]

With respect to the HAC statutory exemption criteria, the need to first immunize hearing aids before compatibility is addressed means that the criteria have not been met. No public interest justification[16] exists for removing the exemption until hearing aids have been designed to be compatible with cell phones – *i.e.*, immunized to essential phone transmissions. The positive

[13] *Id.* at ¶ 15.
[14] *Id.* at ¶ 16.
[15] *Id.* at ¶ 17.
[16] *Id.* at ¶ 20.

effect on people with hearing disabilities[17] will be much greater if the first step is improving hearing aids. Most important, for all the reasons set forth above, it technologically is not feasible for cell phone manufacturers to solve the problem alone;[18] this seems obvious considering that some hearing aids pick up interference from cell phones across a room. Finally, imposing some new form of "compatibility" requirement on cell phone makers before resolving the problem of hearing aid immunity could severely diminish the marketability of the phones.[19] This is because the only way to achieve consistent interoperability would be to weaken the signal from the phone so substantially that it would not reach any tower and therefore would not function properly.

IV. TECHNOLOGY TO IMMUNIZE DEVICES FROM INTERFERENCE IS WELL KNOWN AND GENERALLY INEXPENSIVE

Methods to prevent electronics products from picking up interference have been well known for decades and are applied in thousands of different products. Producers of electronic products who have found that their products are sensitive to undesirable interference have engaged either their own engineers or outside engineers to eliminate the interference. For example, modern automotive electronics are designed to prevent other technologies' signals from being picked up and car radios are designed to avoid picking up interference from the car's engine and electronics. The electronic controls on motorized wheelchairs were modified to eliminate interference that they were picking up from cell phones. Garage door openers must be designed to prevent some other signal from making the door go up and down. Thus, eliminating

[17] *Id.* at ¶ 22.
[18] *Id.* at ¶¶ 25-27.
[19] *Id.* at ¶ 28.

this type of interference is a daily electronic design specification, and manufacturers of all types of products regularly accomplish it.

The protection of electronic products from unwanted sensitivity to extraneous frequencies and fields is practiced not only for far-field frequency generators and fields, but also for proximate generators and fields. The cell phone itself is a good example of such protection. Within the same small cell phone housing, in fact often on the same small circuit board, is not only a transmitter that is strong enough to reach towers miles away, but also a very sensitive receiver that can pick up faint signals sent by that far-off tower. Furthermore, the two frequency ranges are very close to each other. Nevertheless, the receiver and speaker portions of the phone operate without any noticeable interference from the pulsed signal being generated only millimeters away. In fact, the Commission counts on the ability of products to separate the desired signals from the undesirable ones as a core element of the entire radio communications system. Unless radio products can be designed to pick up only the desired frequencies, the division of the radio spectrum into different usage bands cannot work.

Not only is protection from unwanted frequencies a well-understood engineering concept, it has been demonstrated to be applicable to hearing aids. Immunization typically can be done at a low cost and with tiny parts. The right miniature capacitors, costing only pennies, are often sufficient to eliminate most undesired potential interference. While finding the right parts and the right placement requires an understanding of RF engineering, most RF engineers are knowledgeable and "how-to" texts are available. The capacitors used in these solution generally cost less than 5 cents, and they are tiny. Compared with the total cost of a hearing aid, the cost

of such components really is insignificant. Shielding may also be effective to combat RF interference. As the Commission's *NPRM* notes, "shielding behind-the-ear hearing aids with a metallic coating is relatively easy and apparently very effective."[20]

In Europe, a Working Group was convened in Denmark to study and report on "Interference with hearing aids caused by GSM digital cellular telephones" as well as a new LAN phone technology.[21] In the "Remedies" section of the "Conclusive Report," issued in June 1994, the only remedies pertaining to GSM are: "Changes in the construction of hearing aids."[22] While the Working Group determined that, because of variations in hearing aids, it would be best "to leave it to the individual hearing aid manufacturers to seek advice on increased immunity of the equipment," the Working Group did determine that three methods to achieve immunity existed: (1) reduction in the size of the hearing aid (to reduce internal wiring that could pick up interference), (2) use of capacitors, and (3) shielding.[23] The Working Group concluded that it would be "possible to ensure a high degree of immunity through the use of one or several of the above methods" in future hearing aid design.[24] Subsequent European and international standards activities were undertaken for hearing aid immunization, prompted by the work of this group.[25]

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[20] *Id.* at ¶ 8.
[21] Conclusive Report by the Working Group on GSM and DECT Telephone and Hearing Aids: *Interference with hearing aids caused by GSM digital cellular telephones and DECT digital cordless telephones* (June 28, 1994).
[22] *Id.* at 25.
[23] *Id.* at 26.
[24] *Id.* at 26.
[25] *Id.* at 30.

V. HEARING AID MANUFACTURERS ALREADY HAVE DEMONSTRATED AN ABILITY TO ELIMINATE OR SIGNIFICANTLY REDUCE INTERFERENCE

Nothing is inherent in the technology of a hearing aid that prevents it from being made immune to unwanted interference like other types of electronic devices. In fact, in the U.S., some individual users of hearing aids have asked their hearing aid manufacturers to improve the performance of the hearing aid when used with a cell phone. In such cases, the hearing aid manufacturer or the audiologist often has been willing and able to make minor adjustments to the hearing aid to eliminate the interference, at least to a significant degree. Moreover, some of the newer hearing aids are incorporating more sophisticated designs and components to reduce interference generally, and, based on users' anecdotal information, these hearing aids work much better with cell phones.

The best example of what can be done in this area comes from Australia, where the interference problem has been reduced dramatically. In Australia, the government took a lead role in spurring development of hearing aid designs with increased immunity and had hearing aids produced based on such designs. Now most Australians wearing these hearing aids successfully use CDMA cell phones, digital phones that are similar to ones used in the United States.

In Australia, persons who have retired or are on the Australian equivalent of Social Security and Medicare use the vast majority of hearing aids, which the government provides. When the interference issue was raised in the early 1990s, the Australian Government

commissioned a study by the National Acoustics Laboratories ("NAL"). A report issued in 1995,[26] which followed up on an earlier report issued in 1993,[27] analyzed in depth the technical aspects of the issue, the reasons for interference, the performance of various product designs and components, and, in particular, interference between hearing aids and GSM phones then used in Australia. The *1995 Report* noted that the "interference mechanism is intimately associated with the essential nature of the mobile telephone emissions and not an incidental by product;" therefore it could not be solved with some change to the phone, such as shielding.[28] Both the *1995 Report* and the *1993 Report* concluded that the interference problem should be addressed primarily in the hearing aid itself.

The *1993 Report* found that:

> From the experimental work we can say that the interference occurs at the most sensitive part of the hearing aid amplifier, where the RF field induces signals in the wires connected to the microphone or the telecoil and detected (rectified) by the transistor input, and possibly by the output of the microphone which has a simple buffer amplifier. This mechanism applies in high gain audio amplifiers such as those used in public address systems that are subject to AM radio and television transmissions. These are normally shielded from this interference and the input shorted by a small capacitor to eliminate the problem.[29]

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[26] NAL Report No. 131, *Interference to Hearing Aids by the Digital Mobile Telephone System, Global System for Mobile Communications (GSM)*, National Acoustic Laboratories (May 1995) (hereafter the *1995 Report*).

[27] *Interference to Hearing Aids by the new Digital Mobile Telephone System Global System for Mobile (GSM) Communications Standard Preliminary Report* (Mar. 30, 1993) *attached as* Appendix 6 to *The 1995 Report* (hereafter the *1993 Report*).

[28] 1995 Report at 2

[29] *1993 Report* at 4.

The key to avoiding interference, based on this analysis, was likely to be the use of capacitors, as filters; the *1993 Report* suggested:

> The shunt capacitor is a simple filter. It should be placed physically very near the amplifier integrated circuit chip with very short wires. It may also be necessary to place one across the microphone output at the microphone. The capacitors are restricted by their affect on the circuit operation as well as taking up valuable space. By using a small ferrite inductor in series with the microphone leads in conjunction with the shunt capacitor, it may be possible to eliminate interference.[30]

Based on this technical analysis, the government had hearing aid protective circuitry designs developed and tested and then modified the design of its hearing aids accordingly. A standard also was adopted for hearing aids. It established two levels, or classes, of immunity. At Class 1, the hearing aid would protect itself against interference from a digital phone a meter away. At Class 2, the hearing aid would protect itself against interference from a digital phone held at the ear. All hearing aids manufactured after July 1, 1999 were required to comply with the Class 1 standard – compliance with the Class 2 standard remained voluntary, although the *1995 Report* suggested that Class 2 be mandated[31] and NAL is now designing hearing aids to the Class 2 standard. As a result, usability of GSM phones was demonstrably improved, but the improvement was even greater for CDMA phones. In 1999, when CDMA was being introduced into Australia, the NAL again was commissioned to assess the hearing aid interference situation. It found that the filtered hearing aid circuitry generally allowed users to use CDMA phones. The NAL reported:

> Testing with the hearing aid mounted on the head indicates that all clientele using any of the three programmable hearing aid models will "not perceive" any interference with the

[30] *Id.*
[31] *1995 Report* at 49.

> CDMA "clam" phone oriented in the normal usage position and operating at the maximum test power in the full vocoder rate. Estimates indicate that this applies to 191,000 hearing aid users. When operating in the variable vocoder rate at the maximum test power, 78% of Australian Hearing clientele corresponding to 182,000 hearing aid users will have interference that is either "not perceptible" or "just perceptible."[32]

The NAL also noted that "improvements in hearing aid technology should increase the immunity for future model hearing aids."[33] Movement of more hearing aids to the Class 2 standard will help to improve compatibility going forward.

Once the basic design work was complete and the hearing aid circuitry design was modified as developed, the cost of the circuit solutions developed in Australia was not expensive. The filtering of the circuit generally involved less than 25 cents in additional parts per hearing aid.[34] The Australian government also provided what it had learned about protective circuitry to other hearing aid manufacturers selling into the Australian market. The result is that in Australia today, little interference generally exists between cell phones and new hearing aids.

The same basic approach certainly could work in the U.S. The telecommunications industry, through TIA, would be happy to contribute the assistance of knowledgeable RF engineers to help the hearing aid industry develop circuit templates, identify inexpensive components, and offer additional assistance to provide hearing aid manufacturers with a guide to a solution. This assistance and cooperation can lead to major advances in the design of hearing aids that largely solve the problem, as was accomplished in Australia. Hearing aid manufacturers should then be afforded a reasonable amount of time to add such components or

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[32] *Assessment of Interference to Hearing Aids used in Australia by CDMA Digital Mobile Phones*, National Acoustic Labs (Aug. 13, 1999), at page 4.
[33] *Id.*
[34] Industry discussions with senior engineer at National Acoustics Laboratories (Dec. 17, 2001).

other modifications in an efficient manner to their designs. With such engineering circuit design assistance and identification of inexpensive and miniature components to use in the design, the solution generally should not have any noticeable economic impact on the hearing aid manufacturers or their customers.

VI. THE BEST APPROACH TO ADDRESS THE PROBLEM IS TO SET THE ULTIMATE GOAL AND ALLOW BOTH THE WIRELESS DEVICE INDUSTRY AND THE HEARING AID INDUSTRY TO FIND THE SOLUTIONS

The one certain aspect of the future of user interfaces to telecommunications systems is that they will be different than they are today and that the choice of interfaces will increase. For example, as more and more functions get loaded into the typical cell phone, from data transmissions to paging to instant messaging to web surfing, the transceiver portion is less and less likely to be held to the head or face. Every day, more and more cell phone conversations are "hands free," many with the use of a headset and/or earpiece, still others by speakerphone with a remote microphone. In noisy environments, in situations with limited ability to use one's hands, and in many other settings, the benefits of such technology advances are obvious. As the Commission is well aware, it often is inefficient and counter-productive to try to dictate a solution geared to a particular current product technology or usage because the market may move past that technology, making the solution anachronistic or useless.

In terms of the issues before the Commission in this proceeding, the challenge is ensuring that users of hearing aids can use a cell phone. The allocation of precious resources should look forward, not backward. To commit a substantial portion of limited resources to technology that may soon be out-of-date or in limited use is to misallocate such resources. TIA encourages the

FCC and other U.S. Government agencies and departments to set the ultimate goal and then let the designers and engineers in the industries figure out how to achieve that goal in a way that meets the needs of the consumers of those products. For example, it might be feasible to design a phone that is connected by Bluetooth or some other very low power RF technology to an earpiece that serves as a hearing aid. If the whole market moves to wireless earpieces, those with hearing aids essentially will hear phone calls in the same manner everyone else does.

Similarly, some of these same technologies may result in dramatic changes in the hearing aid industry. Hearing devices that pick up sound in a small separate unit and send it wirelessly to a tiny Bluetooth receiver in the ear might be the wave of the future in hearing aids. Or the hearing assistive device of the future could connect wirelessly to multiple possible sources of sound, including the home wireline phone terminal, the home television set, the FM radio, and the user's wireless device. These future developments could create new and different opportunities for use of cell phones by persons who need hearing assistance. TIA has serious concerns that any governmental regulations or mandates that impose compatibility requirements to the *current* state of technology and usage will result in requirements that are obsolete and inefficient for both users and the industry.

VII. WITH GOVERNMENT LEADERSHIP, INDUSTRY CAN ASSIST HEARING AID MANUFACTURERS TO IMMUNIZE HEARING AIDS IN ORDER TO MINIMIZE THE RF INTERFERENCE PROBLEM

U.S. Government leadership to motivate hearing aid manufacturers to immunize hearing aids would greatly reduce the RF interference problems experienced by hearing aid users. Government leadership in Australia underscores this fact. The Australian Government initiative

has been successful in that country in addressing the problem with cell phones and hearing aids. Substantial steps also have been taken in Europe. No reason exists why this approach cannot be utilized effectively in the United States. The solution is to make sure that cell phones continue to perform and operate within the narrow ranges prescribed by the FCC and by industry standards. In fact, the FCC already does this. The FCC has long experience, expertise and authority to require that cell phones generate specific frequencies, signals and transmission protocols. This offers the manufacturers of hearing aids a clear target to which to design their hearing aids in order to make them immune to the signals and fields generated by cell phones.

Once the target for immunization is clear for hearing aid manufacturers, an immunization solution is well within reach. This has been the experience in Australia. The cell phone industry is ready to support this effort with resources. The industry is ready to help the hearing aid industry determine what modifications will help to minimize interference in their devices. The basics of immunization are not only generally well known and the subject of existing treatises on RF and interference, but specific information on making hearing aids immune to cellular technologies such as CDMA and GSM has been developed in Australia and is publicly available for guidance.

In addition, the cell phone manufacturers are ready to help hearing aid manufacturers locate inexpensive parts and components that can be used to create such circuits. Again, the experience from hearing aid manufacturers who have done so already provides sound guidance. Other government agencies can play a role as well, and the members of the cell phone industry would be happy to work with them in this effort, to the extent that would be helpful. The Food and Drug Administration (FDA) could help to distribute know-how, circuit technology

recommendations, or other information helpful to hearing aid manufacturers in producing devices that are less susceptible to interference, not only from cell phones, but also from the many other sources that cause interference in hearing aids.

VIII. CONCLUSION

The telecommunications industry has continued to move forward in developing ways that cell phones can be used with hearing aids, despite their exemption from the requirements of the HAC Act. Conversely, eliminating the HAC exemption for cell phones will not enable this industry to solve the problem of hearing aids unintentionally picking up interference from cell phone signals and fields. In fact, the HAC Act did not anticipate the issue of RF interference, and therefore it does not even address it.

If the Commission were to conclude that removal of the HAC Act exemption would result in an FCC requirement that cell phone manufacturers solve the interference problem by themselves, it cannot be lifted, because neither the third criterion – "Technological Feasibility" – nor the fourth criterion – "Marketability of Telephones" is met. Rather, the Commission should foster joint information and educational exchanges between the hearing aid industry and the cellular phone industry to increase the opportunity to understand the limitations and technical parameters that each industry works under in designing and developing their respective products. This can lead to a better understanding of the mutual and severable responsibilities that each industry has to solve interference problems.

This is the time to map out an end game for this issue. TIA and its member companies want to get as quickly as possible to the point where all hearing aid users can use virtually any cell phone. We stand ready to do our part and to help the hearing aid industry develop solutions for its products and to do so as quickly and inexpensively as possible. As new technological possibilities emerge, the telecommunications industry hopes to work cooperatively with hearing aid manufacturers to explore whether these new technologies provide new or alternative means of enabling hearing aid users to be cell phone customers. We would like to work with the Commission and other U.S. Government agencies, such as the FDA, to make this happen and at the same time, perhaps, improve hearing aid immunity to other sources of interference as well.

Respectfully submitted,

Telecommunications Industry Association

Matthew J. Flanigan
President

Grant E. Seiffert
Vice President
External Affairs and Global Policy

Derek R. Khlopin
Director, Law and Public Policy

1300 Pennsylvania Avenue, NW
Suite 350
Washington, DC 20004

(202) 383-1480

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